SPACE CENTER
# Roundup

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# Extraterrestrial liquid found in second meteorite

A team led by NASA-JSC scientist Dr. Michael Zolensky recently announced that, for the first time, liquid water had been found in an object from space. This discovery was reported in the August 1999 issue of the journal *Science*.

Shortly after this discovery was announced, news of another meteorite that fell in 1998 in Morocco was reported. This second meteorite contains dark blue halite – a mineral found in the meteorite examined by Zolensky's team – and has inclusions of a fluid, believed to be water.

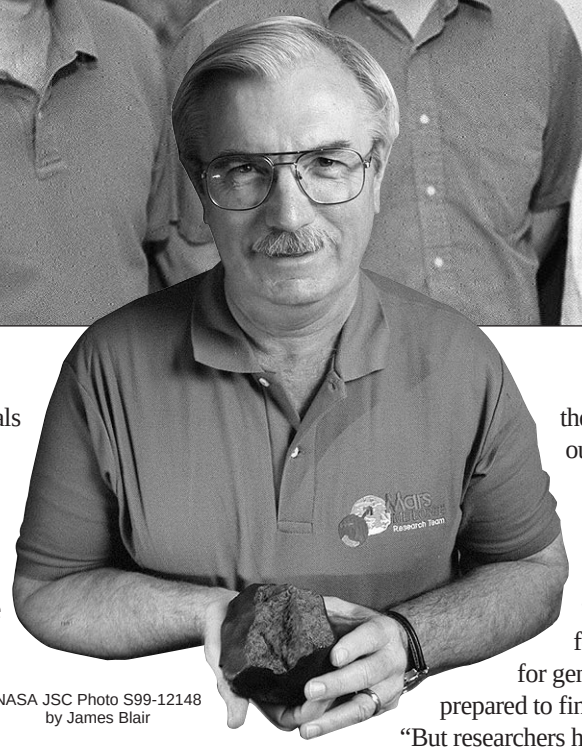
This second discovery supports Zolensky's belief that meteorites containing water are probably not scarce. But by the time researchers get their hands on the meteorites, halite and other minerals that trap the water have dissolved away, and the water has evaporated. "This phenomenon of having liquid water in meteorites might be fairly common," says Zolensky.

On March 22 last year in Monahans, Texas, a meteorite streaked across the sky and fell to Earth. Upon quitting their basketball game, a group of seven boys went over to inspect it. What they found was a black, grapefruit-size rock.

The next day, NASA-JSC space scientist Dr. Everett Gibson arrived and took the meteorite, later named Monahans 1998, back to JSC for analysis. In a JSC clean room two days later, the rock was carefully opened with a hammer and chisel. Researchers found halite crystals inside, and within these crystals they found bubbles of water, marking the first time that anyone has found liquid water in an object recovered from space-and a potential indication that life may exist outside our planet.

Because Monahans 1998 was recovered rapidly and isolated from terrestrial contaminants such as moisture from our atmosphere within two days after it hit Earth, researchers had an atypically fresh sample to test. The scientists were excited to find blue and purple crystals of halite inside. Halite is a salt crystal that is usually formed from evaporation of briny water.

NASA JSC Photo S99-12531 by James Blair

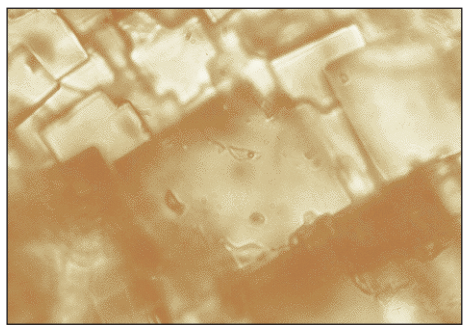


NASA JSC Photo S99-12148
by James Blair

**The Monahans 1998 Meteorite Team members include, from left, Dan Garrison (Lockheed Martin), Dr. Mike Zolensky (NASA), Kathleen McBride (Lockheed Martin), Dr. Larry Nyquist (NASA), and Dr. Don Bogard (NASA) (above).**

**Dr. Everett K. Gibson shows a model of one of the two Monahans (1998) meteorites bearing the unusual salt crystals (at left).**

**Researchers found halite crystals (table salt) inside the meteorite, and within these crystals they found bubbles of water (below left).**



The crystals have turned blue and purple because of the radiation they received from the radioactive decay of potassium 40 within the salt. JSC scientists Dr. Larry Nyquist and Dr. Don Bogard have dated the halite and found it to be 4.5 billion years old. That means that the trapped water could predate the sun and planets in our solar system.

The crystals were up to 3 millimeters (about a tenth of an inch) in size. These are the largest halite crystals ever seen by scientists in any extraterrestrial material. The presence of briny water inside the crystals was confirmed by shining a laser beam through the bubbles and measuring the resultant light spectrum. The brine could have been flowing within the asteroid itself when it was in space or it could have been deposited on the asteroid by a passing object, such as a comet.

"Water has been recognized previously in meteorites but it is usually chemically combined within selected low-temperature phases," said Gibson. "Discovering liquid water within the halite trapped within high-temperature silicates of the meteorite was the real surprise. The water was essentially fluids left over from the time of formation of our solar system."

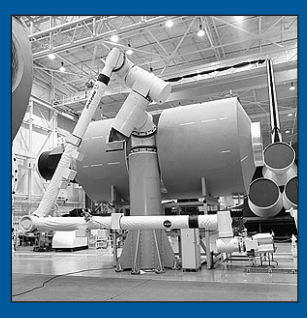
Scientists did not expect to find water in the type of meteorite in which it was found. "We have been looking for water in meteorites for generations, so we were prepared to find it," said Zolensky. "But researchers have been looking for water in meteorites that are considered to have been formed from water and contain clay minerals."

Researchers were equally surprised to find water in halite, a mineral they never expected to find in a meteorite. Sodium chloride, or table salt, is commonly found on Earth. Having this in a meteorite implies that there were tremendous quantities of water on this asteroid-much more than researchers had hitherto thought.

The brine inclusions discovered in Monahans 1998 provide the first opportunity for the direct analysis of a meteoritic water sample, but such an analysis is difficult because of the small size of the inclusions. Each inclusion contains on the order of a picomole of water, which is beyond the capability of high-precision mass spectrometers by about a factor of a thousand. But according to Zolensky, scientists in England have access to instruments that can perform this analysis.

Plans call for this research to be completed within a year.

In the coming year, researchers plan to look for more samples, searching for liquid water inclusions not only in halite but also in other minerals in meteorites. Scientists also have arranged to have other collaborators examine the contents of the fluid in Monahans 1998. Knowing how much calcium, iron or magnesium is in the fluid will help researchers determine where this water has been and how long it has been in the asteroid. Thirdly, researchers will try to find out what the isotopic composition of the water itself is by looking at the oxygen and hydrogen isotopes in the water. This analysis will tell scientists more about the origin of the water-whether it came from our solar system or from somewhere else. ■



Astronauts use new robotic arm in training.

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Staying active is best remedy for aging.

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